Developing information system to improve hinterland productivity and rubber multimodal transportation in South Sumatera Indonesia

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Developing information system to improve hinterland productivity and rubber multimodal transportation in South Sumatera Indonesia

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Abstract. There are many losses in nodes of the rubber supply chain. Rubbers are brought by boat to the Musi river estuary and sent to Mother Vessel near Singapore. If the nodes, where the rubber production is supposed to be collected, are not in function, then the rubber chain will be damaged. Farmers prefer to keep their rubber at home and wait for the middlemen to buy and collect them directly from their home. The productivity of rubber fell sharply as the price went down, and several big factories that have been shut down. This study aims to identify the characteristics of rubber trips, analyze the Nodes of the element of multimodal trips and multimodality per segment of rubber commodity trips, and make scenarios of improvement of the transport system for rubber in South Sumatera by means of information technology system. Transport data is analyzed by Matrices Analysis followed by VISUM program analysis. Interpretation of Land Image to recognize the area of rubber plantation is carried out using Image Landsat 8 and multispectral Analysis. The results will be the information system to improve hinterland productivity and multimodal rubber transportation.

1. Introduction

The booming era of rubber production happened in 2013 at South Sumatera. According to the 2014 statistics of South Sumatera, rubber contributed the biggest amount of regional income, as much as US$ 2,310.02 million dollars, followed by coal US$ 159.68 million and a fraction of palm oil US$ 127.59 million (Central Bureau Statistics of South Sumatera, 2014). Currently, the rubber price fell down to the lowest price at Rp. 7500,- for 40% dryness, while the highest price is at Rp 18,700 for 100% dryness. Rubber supply chain process that started from plantation to the destination countries through the Ports is quite long. Several segments of the supply chain did not work very well. The previous study showed that the total tonnage of rubber production from rubber plantation is not compatible with the registered production number in the trade bureau. There are substantial losses from the supply chain process [1]. The results of National Origin Destination Survey (ATTN) between 2001 and 2006 revealed that almost 90% freight trips are the road transport mode, and only 7% are sea transport, rail, and air transport. Connectivity index in South Sumatera is 1.33 [2]. Many plantation areas are still not connected to the main road, which resulted in longer and more expensive freight transport. Freight Multimodal Transportation is a two or more transport modes, which are connected

and integrated, with one document or payment system. Multimodal Public Transport System has similar six elements that can be adapted to Freight Transportation; connecting modes, main modes, main network and feeder, transfer point, intermodal transfer point and regulation as countermeasures [3]. Area recognition, which uses remote sensing method, has been known worldwide due to its time and cost saving benefit. Several researchers used NDVI, NDSI, and NDWI method. While others use remote sensing and GIS to detect changes in vegetation a case study of Wellore district [4]; analysis of land use in the Banyuasin district using the image Landsat 8 by NDVI method [5]; Spatial analysis of soil texture and peat soil by NDSI method at swamp area of Banyuasin District [6]; analysis of puddles in swamp area of Banyuasin District using the image Land sat 8 by NDWI method [6]. This study classifies rubber plantation based on its texture to obtain the area of plantation. The rubber production number is derived from the average production per Ha per day, this number is obtained from interviews. A number of research regarding Rubber Information system have been published, such as A Project on Development of Rubber Information System [7]. This paper has concluded from its further research that the need to utilize information system for stakeholders such as Farmer Cooperation (UMKM), transporter, government, and processing factory has been developed. The database helps people organize the information and interconnect between one and another to be an easily accessible logical shape [8].

1.1. Problem formulation

Problem Formulation is defined in the following options:

1) How is to identify the potential productivities of rubber plantation by interpreting Aerial Map
2) How to identify the freight trip characteristics of export rubber commodities? How to analyse multimodality of rubber trips.
3) How to develop the information system in order to improve hinterland productivity of multimodal rubber transportation in South Sumatera.

1.2. Aim of the study

The aim of the study is:

1) To identify the potential productivities of rubber plantation by interpreting Aerial.
2) To identify freight trip characteristics of export rubber commodities and analyse multimodality of rubber trips.
3) To develop the information system in order to improve hinterland productivity of rubber multimodal transportation in South Sumatera.

2. Research method

This research was carried out as described in figure 1.

In the image data processing, several steps were carried out as the following:

- Pre-processing step, which consists of combining two or more images from different scans, cutting image process to limit the study area and also reduce the size of image file; and the radiometric correction process to locate the Image in the coordinate system in Indonesia.
- Processing step, which consists of Red Green Blue (RGB) colour composition process to sharpen the visibility of certain objects, according to the need of land classification?
- Multispectral classification to classify the homogeneous visibility into categories.
- Field test process is the final test to check the accuracy of the interpretation process and land classification based on the prescribed criteria.

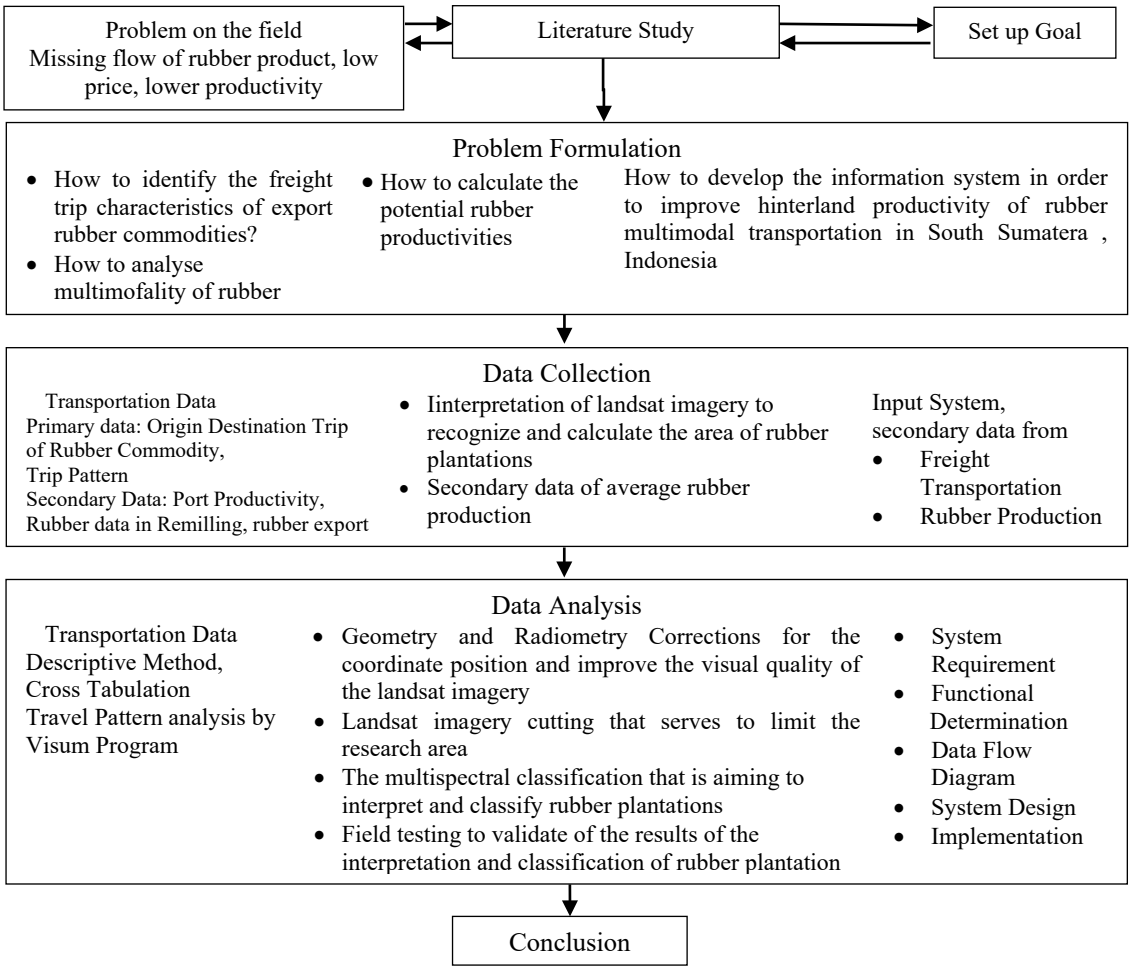

Figure 1. Flow chart of research.

The study area of land classification for agriculture and plantation is shown in figure 2.

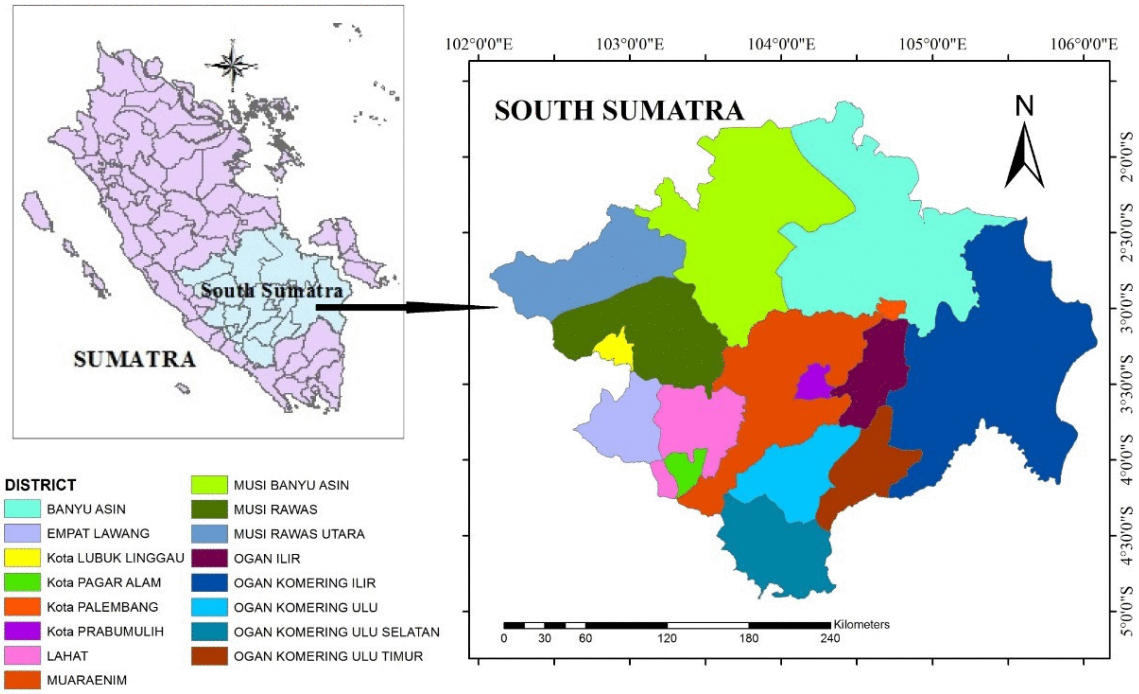

Figure 2. Map of land classification for agriculture and plantation in South Sumatera.

3. Results and discussion

3.1. Data of rubber production

Descriptive Data of Rubber production in Banyuasin District and Musi Rawas is explained in table 1.

Table 1. Characteristics of rubber farmer in Kabupaten Banyuasin and Mura, South Sumatera.

No.	Characteristics	Interview Results
1	Daily Production of Rubber from Banyuasin District	5-10 kg/day/ha (22%); 10-15 kg/day/ha (44 %). 15-20 kg/day/ha (25 %); 20-25 kg/day/ha (9%),
2	Daily Production of Rubber from Musi Rawas	10-15 kg/day/ha 42 %; 24 % 5-10 kg/day/ha; 26 % kg/day/ha 15-20 %.

from the Secondary Data of Trading Agency, South Sumatera, the importers are China, USA, India, South Korea, and Germany. With Germany as the main importer.

3.2. Interpretation of rubber land plantation

Interpretation of rubber plantation is carried out to calculate the rubber land area. Texture image from satellite is shown in figure 3.

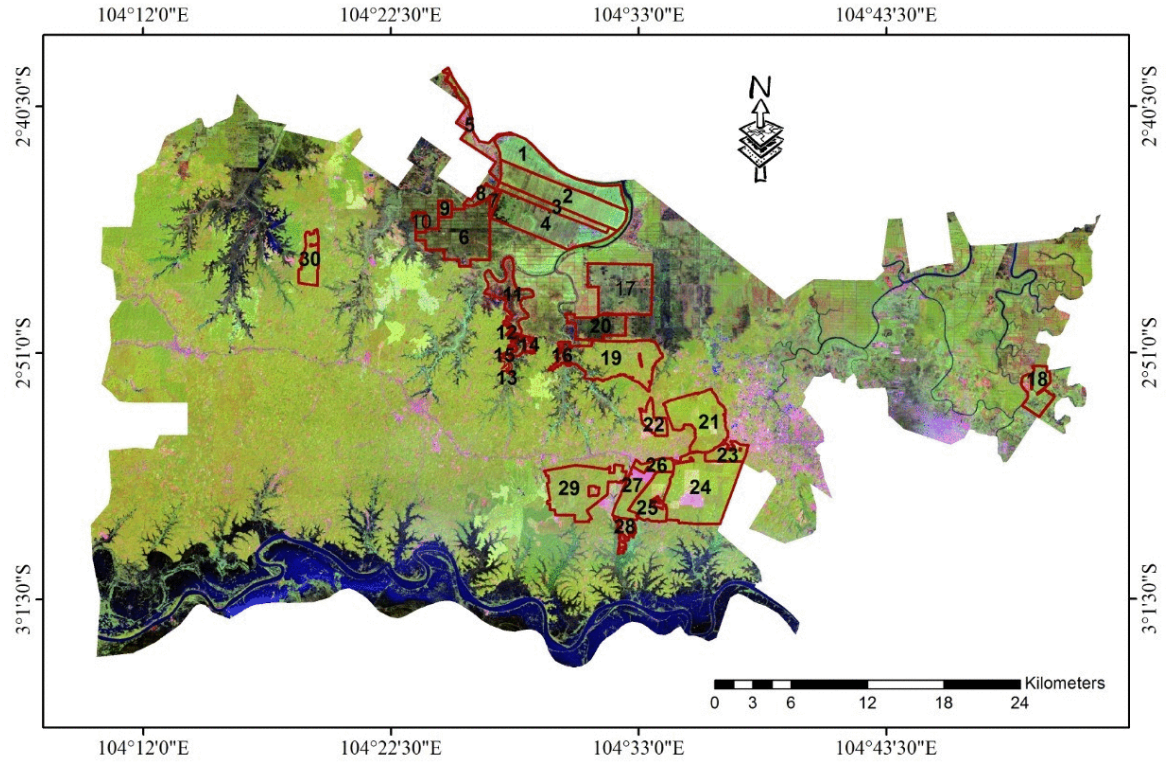

Figure 3. Study area in Banyuasin District.

The obtained land area is classified as the rubber parcel area (1 to 30 parcels). One out of 30 parcels are classified in figure 4.

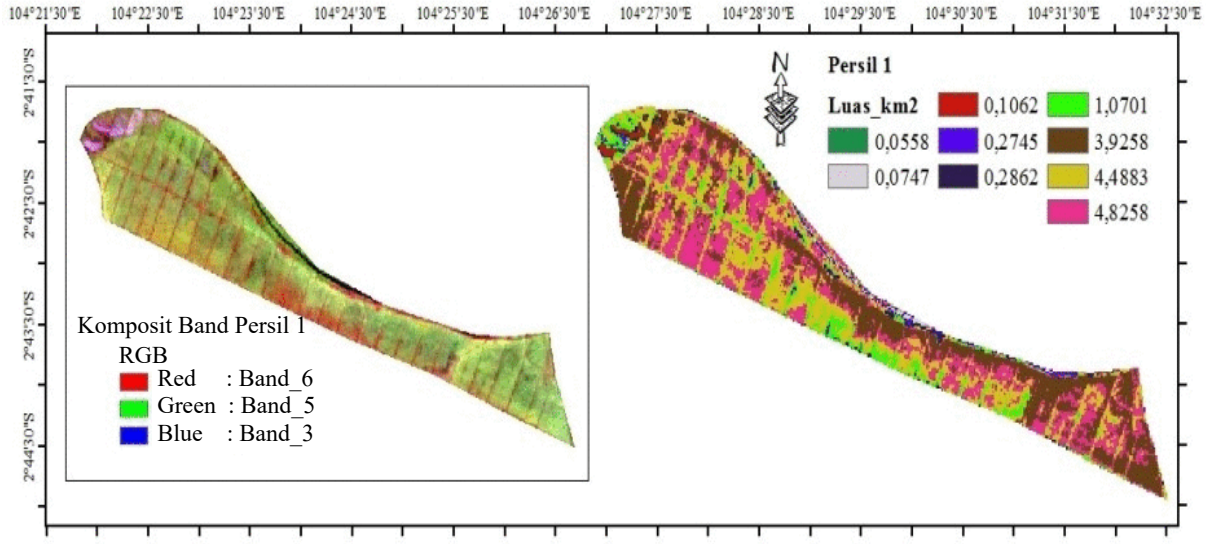

Figure 4. Classification of Parcel 1 of rubber plantation based on the texture.

Rubber Plantation Area and Rubber production per day per ha is presented in the table 2.

Table 2. Percentage of rubber plantation area and rubber production per day per ha.

No. of parcel	Area (ha)	Rubber Production [a] (kg/day/ha)	Percentage of parcel area of total rubber area in Banyuasin District (%)	No. of parcel	Area (ha)	Rubber Production [b] (kg/day/ha)	Percentage of parcel area of total rubber area in Banyuasin District (%)
1	1510.74	18129*	1.69	16	117,18	1406	0.13
2	1793,16	21518	2.00	17	1809,18	21710	2.02
3	482,85	5794	0.54	18	631,08	7573	0.71
4	1884,78	22617	2.11	19	1893,60	22723	2.12
5	720,63	8648	0.81	20	720,99	8652	0.81
6	1858,68	22304	2.08	21	1551,15	18614	1.73
7	92,70	1112	0.10	22	313,11	3757	0.35
8	186,21	2235	0.21	23	376,74	4521	0.42
9	131,85	1582	0.15	24	2502,63	30032	2.80
10	139,86	1678	0.16	25	733,95	8807	0.82
11	836,46	10038	0.93	26	248,31	2980	0.28
12	149,31	1792	0.17	27	626,49	7518	0.70
13	56,34	676	0.06	28	232,02	2784	0.26
14	76,77	921	0.09	29	1717,02	20604	1.92
15	9,99	120	0.01	30	498,78	5985	0.56

**Area of rubber plantation in Kabupaten Banyuasin is 89513 ha. Average production is 12 kg/day/ha

3.3. Multimodal transport analysis

After the multimodal transport analysis transport is conducted, the data is presented in figure 5.

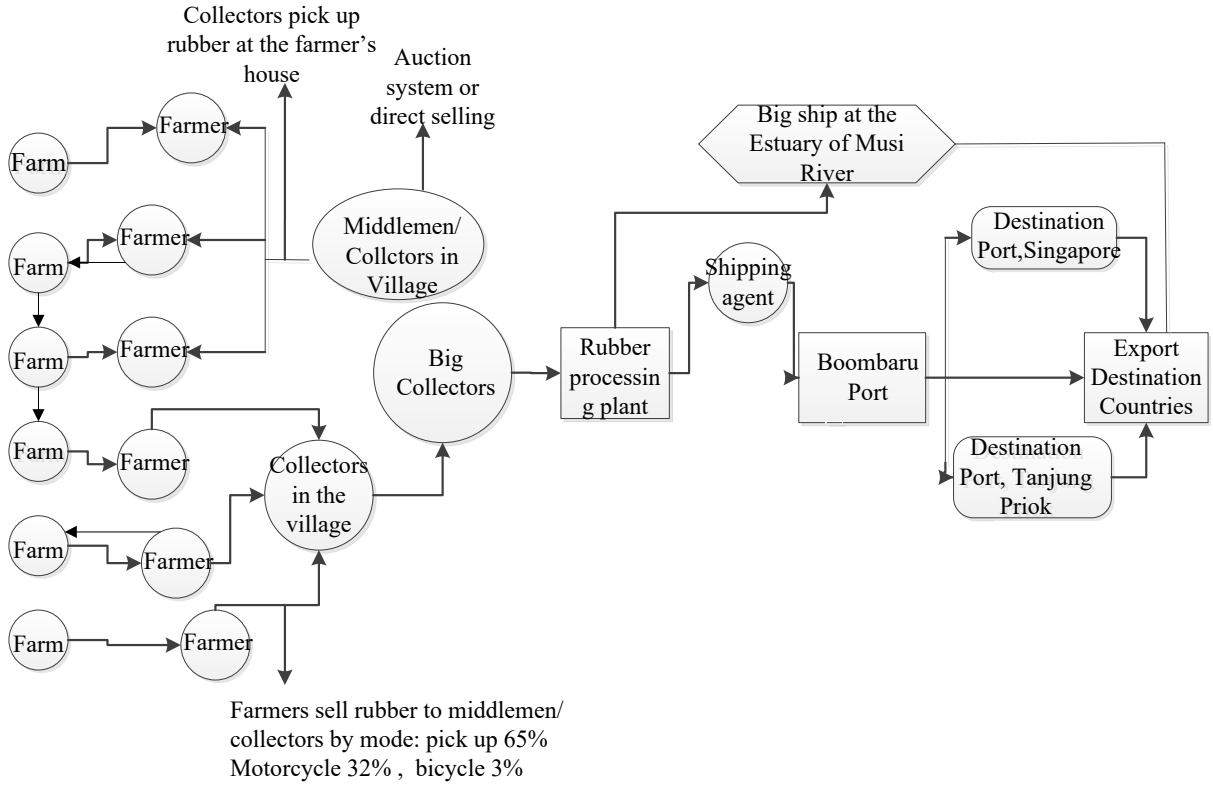

Figure 5. Analysis of multimodal trip of rubber commodities.

3.4. Information system

The web-based system can do the purchasing process, this purchasing process can be monitored in real-time, this means the rubber trade process carried out in a transparent manner. In addition, web

information system and rubber trade should include (1) Web-based or web mobile; (2) User Management in web design that contains: user admin representing the authority of the web, users representing the factory tender, users representing the farmer group; (3) Data of the farmer group and factory which is registered to join the tender; (4) Feature that elaborates the detail of the rubber (weight, quality, age of rubber); (5) Feature that enables to bid the Tender, presented in real-time; (6) Report every tender; (7) Data and tender history. The following figure 6 is the screenshot of the Information System.

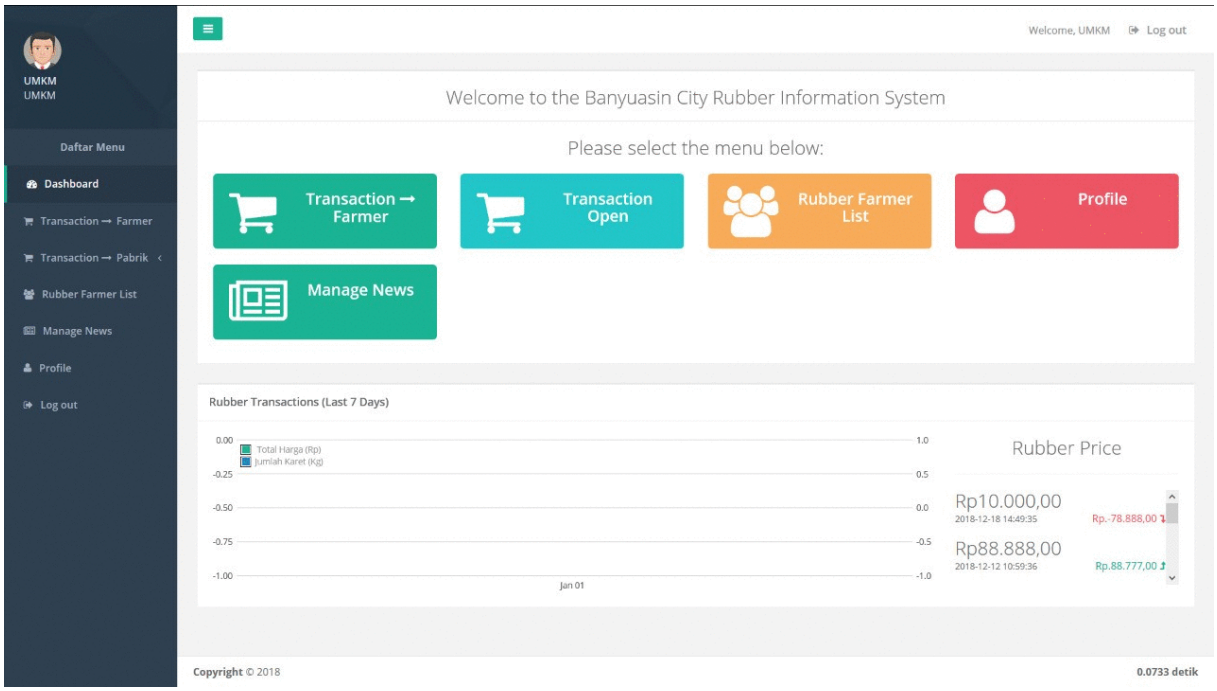

Figure 6. Display of Web Information System of Rubber.

Data Flow Diagram is created as a part of the System Requirement and Functional Determination in order to have a System Design for the Implementation of Web Information presented in figure 7.

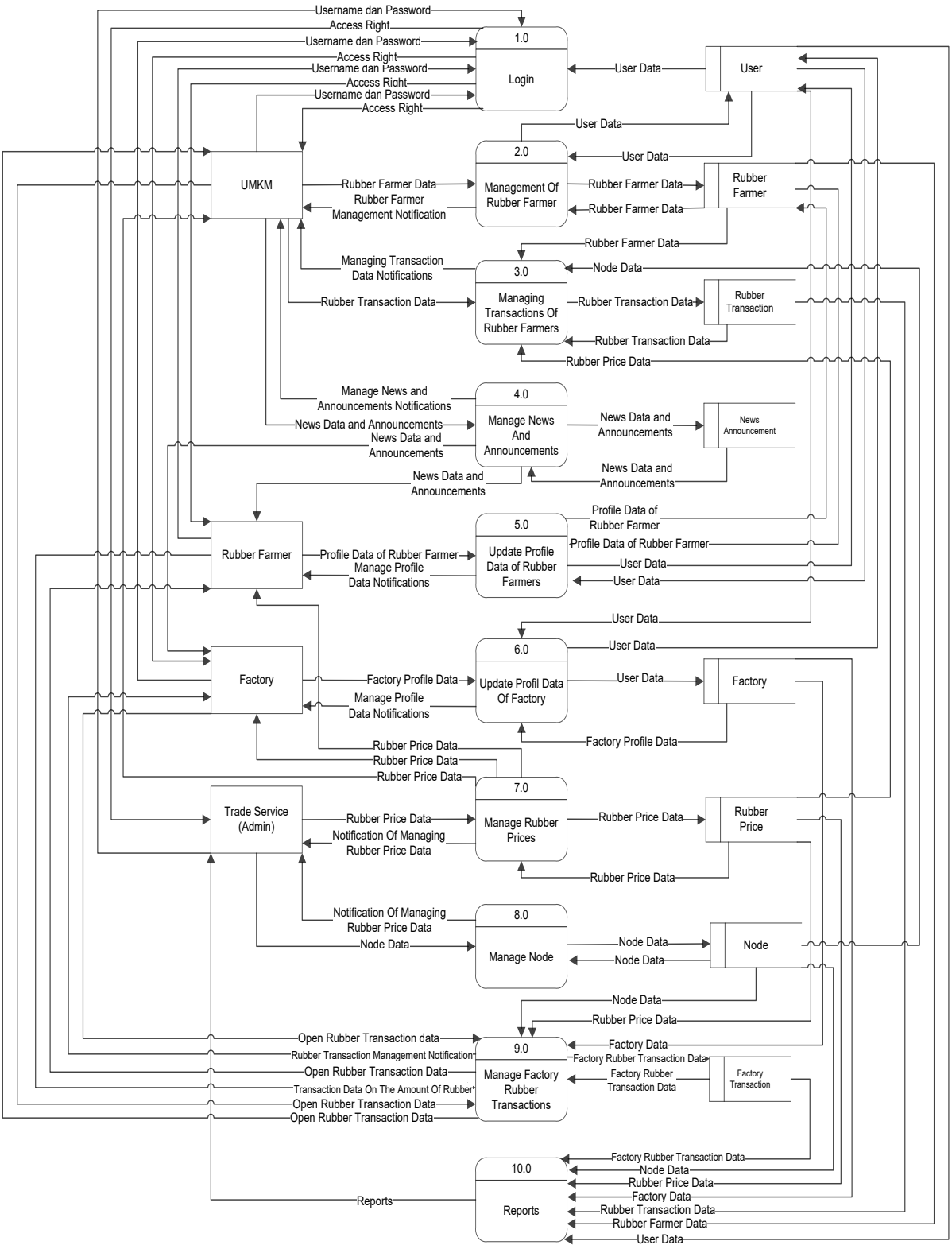

Figure 7. Data flow diagram of rubber information system.

4. Conclusions

From the above analysis and discussion, several points can be concluded;

1) The number of rubber production can be estimated by calculating the land image interpretation and average product per farmer, assumed to be 12 kg, based on the survey results that provide 10-20 kg/ha/day. The total products are an input in the system manually by farmers, so customers will directly understand, and transporters will be able to offer their services to the farmers.
2) Results of the node analysis:
   a. 14% of rubber production is sold and delivered by the farmers to the middlemen, 65% delivered by pick up (mini truck), 32% by motorcycle, and 3% by bicycle.
   b. 81% of rubber production is kept at home by the middlemen, only 5% of rubber are sold to the factory.
3) This information system is created to make the process of collecting rubber easier, increase productivity by providing the transparent price of rubbers, and omit the role of dominant middlemen who sometimes also acts as the transporter.

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